

CHAPTER 1

INTRODUCTION

1.1 Introduction

During the past ten years, the mobile radio communications industry has grown by orders of magnitude, fueled by digital and RF circuit fabrication improvements, new large-scale circuit integration, and other miniaturization technologies which make portable radio equipment smaller, cheaper, and more reliable. These trends will continue at an even greater pace during the next decade.

Wireless operations, such as long range communications, are impossible or impractical to implement with the use of wires. The term is commonly used in the telecommunications industry to refer to telecommunications systems (e.g., radio transmitters and receivers, remote controls, computer networks, network terminals, etc.) which use some form of energy (e.g., radio frequency (RF), infrared light, laser light, visible light, acoustic energy, etc.) to transfer information without the use of wires. Information is transferred in this manner over both short and long distances. Applications may involve point-to-point communication, point-to-multipoint communication, broadcasting, cellular networks and other wireless networks.

Antenna is a very important component for the wireless communication systems using radio frequency and microwaves. By definition, an antenna is a device used to transform an RF signal, traveling on a conductor, into an electromagnetic wave in free space. The IEEE Standard Definitions of Terms for Antennas (IEEE Std 145-1983) defines the antenna or aerial as “a means for radiating or receiving radio waves”. In other words it is a transitional structure between free space and a guiding device that is made to efficiently radiate and receive radiated electromagnetic waves. Antennas are commonly used in radio, television broadcasting, cell phones, radar and other systems involving the use of electromagnetic waves. Antennas demonstrate a property known as reciprocity, which means that an antenna will maintain the same characteristics regardless if it is transmitting or receiving.

One of the application of a one way wireless communication is the terrestrial television. Terrestrial television (also known as over-the-air, OTA or broadcast television) is the method of television broadcast signal (can be analog or digital) delivery by using radio waves from broadcast stations to televisions at homes using air as the medium. In terrestrial TV system, the transmitters (broadcast stations) are transmitting the TV signal with high power and a very tall antenna transmitters located on the ground to transmit radio waves to the surrounding area., Viewers can pick up the signal with a much smaller antenna. The main limitation of broadcast television is range. The frequency range used by the terrestrial television includes the very high frequency (VHF) and ultra high frequency (UHF). The most common antenna used for receiving TV signals are the the Yagi-Uda antenna (variation of the dipole antenna) which is traditionally placed on the roof of the house.

One of the other types of the antenna is the planar antenna. The planar antenna has the most variation compared to any other types of antenna. Due to its advantages such as low profile and the capability to be fabricated using the printed circuit technology, antenna manufacturers and researchers can come out with a novel design of antenna in-house which will reduce the cost of its development. Planar antennas are also relatively inexpensive to manufacture and design because of the simple 2-dimensional

physical geometry. They are usually employed at UHF and higher frequencies because the size of the antenna is directly tied to the wavelength at the resonant frequency.

Fractal geometries have been applied to antenna design to make multiband and broadband antennas. In addition, fractal geometries have been used to miniaturise the size of the antennas. However, miniaturization has been mostly limited to the wire (dipole and loop) antennas. The geometry of the fractal antenna encourages its study both as a multiband solution and also as a small (physical size) antenna. First, because one should expect a selfsimilar antenna (which contains many copies of itself at several scales) to operate in a similar way at several wavelengths. That is, the antenna should keep similar radiation parameters through several bands. Second, because the space-filling properties of some fractal shapes (the fractal dimension) might allow fractal shaped small antennas to better take advantage of the small surrounding space. The fractal antenna is formed by applying a generator shape repetitively at a constant scale factor and results in an antenna with log-periodic characteristics which is a multiband antenna and a miniaturization characteristic.

1.2 Problem Statement

Antenna elements are based on the size of the waves they're designed to receive, and the lower the frequency, the waves are longer, requiring a larger antenna surface to receive them. UHF TV antenna is significantly large and are intended for roof- or attic-mounting.

The use of big outdoor UHF antenna should be replaced with a compact, less expensive and easily manufactured dipole antenna. The fractal geometry combined with the planar dipole can produce an antenna that has the benefit of being compact, low cost, and easily fabricated. The UHF band spanning from 470 MHz - 890 MHz is used for

terrestrial TV broadcast. It will be very useful if the planar fractal antenna can be utilised in this frequency band.

1.3 Objectives

The objectives of this project are as follows:

To design, simulate and fabricate a double sided planar dipole antenna based on the Koch curve fractal geometry and with truncated ground plane, that has operating frequency within the lower UHF band i.e. 470MHz-890MHz which is the terrestrial TV signal frequency band.

1.4 Scope of Project

- (i) Design the antenna based on previous similar works in published journals using antenna design software ,
- (ii) Simulate the proposed antenna using antenna design software (Agilent Advanced Design Systems),
- (iii) Fabricate the antenna using the available materials.

1.5 Organisation of Project Report

This project report consists of five chapters describing all the work done in the project. The project report organisation is geneally described as follows.

The first chapter explain the introduction of the project and problem this project try to solve which describe the motivation of this project. This chapter sets the work flows according to the objectives and scope of project.

Chapter two discuss the types of antennas, theories of planar and microstrip antenna , dipole configuration, and the fractal structure for antennas. Also the equation needed to design the planar dipole antenna is discussed.

Chapter three discuss the steps on designing the planar fractal dipole antenna, the software used for design and simulation, the structure of the designed antennas, and the measurement techniques.

Result and analysis are presented in chapter four to compare the performance of all the designed antennas.

The last chapter highlights the overall conclusion of the project with future work suggestion to improve the design of the antenna. The project is summarized in this chapter to give general achievements and the future improvements can be made by other reserachers in the future.

1.6 Summary

This is an introductory chapter that defines the literature review, the objectives, and research background of the thesis. The project report structure is explained and highlighted. In the following chapters, the project work performed is reported.